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ABSTRACT

This course guide for a plastic technology course is one of four developed for the production area in the North Dakota senior high industrial arts education program. (Eight other guides are available for two other areas of Industrial Arts--energy/power and graphic communications.) Part 1 provides such introductory information as a definition and instructional objectives for Industrial Arts. Part 2 contains the course rationale and objectives; guidelines for implementation; taxonomic structure; course description including length, credit, prerequisites, and student competencies; suggested instructional units with required number of class periods; and 12 units. Each unit includes some or all of the following material: unit objective(s), topic outline, and selected student competencies to be developed through sample coordinated learning activities. Unit titles are Introduction and Orientation, Testing and Chemistry of Plastics, Molding and Forming, Moldmaking, Fabrication and Bonding, Laminates, Casting Plastics, Foaming Systems, Coating, Dispersion System, Decorating, and Career Opportunities in Plastic Technology. A reference list is appended. (YLB)

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PLASTIC TECHNOLOGY

(PRODUCTION)

INDUSTRIAL ARTS SENIOR HIGH--LEVEL II

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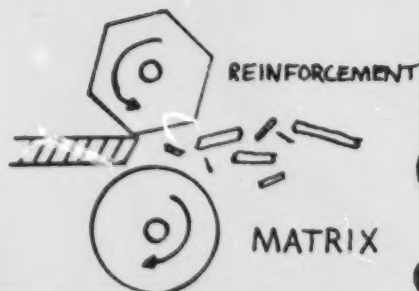
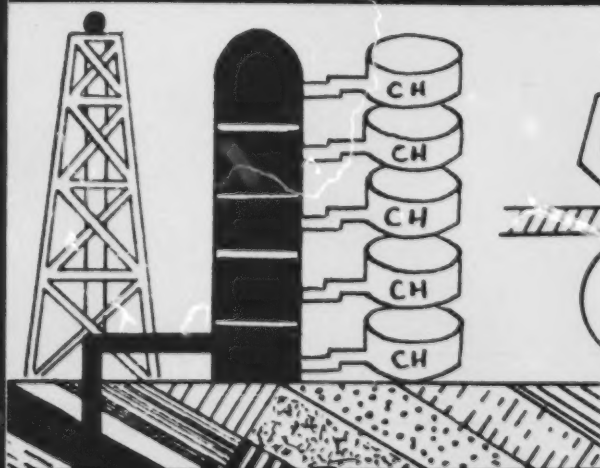
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NORTH DAKOTA SENIOR HIGH INDUSTRIAL ARTS CURRICULUM GUIDES

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PREFACE

One of the biggest challenges facing education today is keeping the instructional content current. Industrial Arts in particular must be quick to respond to changes in our technological society. For many years, North Dakota has offered quality industrial arts programs to students in the public schools. Credit for this is due to the teachers who have shown the desire to continually improve programs, keep their content current, and make instruction relevant.

The Industrial Arts curriculum has boundless potential for courses and program development. However, this program possibility excites the imagination of teachers to offer endless number of courses which causes a need to determine what is of greatest value for students to experience.

Thus, the development of an appropriate or model curriculum requires a critical examination of several undergirding questions: What is the overall responsibility of Industrial Arts? What Industrial Arts goals are appropriate for the different grades or school levels? What courses constitute a meaningful curriculum for these goals to be realized? What shall be the scope and sequence of the total curriculum? The answers to these questions have been addressed by a North Dakota Industrial Arts Master Plan curriculum committee and are recorded in the North Dakota Senior High Industrial Arts Program of Studies booklet.

The Program of Studies describes the complete secondary school industrial arts education. The Program of Studies Booklet emphasizes the Level II Senior High programs with specific courses, course descriptions, objectives and units of instruction. The Junior High-Level I program is dealt with in a general basis for the purpose of articulating the total levels within the total secondary school industrial arts program.

Three types of Industrial Arts programs are included in the Program of Studies along with the individual courses which constitute the complete secondary school curriculum:

1. **ORIENTATION AND EXPLORATION**-- Level I program designed for grades seven through nine.

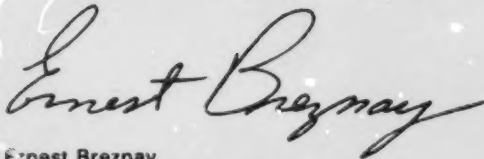
The purpose of this program is to provide students with first-hand exploratory experiences in the four technical cluster areas. The learning experiences should provide an awareness of the impact of industry and its associated technologies on the lives of individuals. Furthermore, this program assists individuals in making informed and meaningful occupational/career choices.

2. **PERSONAL ENRICHMENT**-- The program designed to prepare students with a general education of technological literacy, avocational skills and consumer information. This is purely an elective program of students for students who desire to gain an understanding of the technical concepts for personal satisfaction.

3. **PRE-TECHNICAL**-- This program provides concentrated and specialized technical courses for grades ten through twelve. These courses are articulated with the Level I technical cluster areas. Students at this level have a wide range of interests, abilities, and life aspirations. Therefore, the key element for the senior high pre-technical program is flexibility to meet the varied needs of learners. The program is designed to prepare students for advanced educational or training programs.

The North Dakota Senior High Program of Studies identified twelve different courses recommended to be offered in grades ten, eleven and twelve. The model curriculum lists four courses for each of three technical areas: (1) Energy/power, (2) Graphic Communications, and (3) Production. Individual course guides have been developed for each of the twelve courses recommended for the senior high curriculum. This being one of the twelve course guides. Similar guides have been developed for the remaining eleven.

Each course guide contains the course rationale, objectives, content, units and selected student competencies to be developed along with student learning activities. The primary aim of the course guides is to provide meaningful direction and still leave opportunity for individual teacher creative approaches in meeting the diverse needs of unique school populations. The course guides not only propose to assist teachers and administrators in keeping their programs up-to-date, but also to promote industrial arts education program uniformity among North Dakota schools.



Ernest Breznay
State Industrial Arts Supervisor
North Dakota State Board for Vocational Education
July, 1981

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The North Dakota Industrial Arts profession is indebted to the following individuals who gave their time and talents in the development of the Twelve Senior High Industrial Arts course guides. These teachers and teacher educators attended an Organizational meeting, participated in a curriculum writing seminar, and developed individual course guides during 1980 & 1981.

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BASIC BELIEFS ABOUT INDUSTRIAL ARTS

INDUSTRIAL ARTS IS

- *an educational discipline founded upon the knowledge base of technology - the means by which material things are produced.
- *an instructional program affording boundless opportunities for learning how technology has been, is now and will be basic to human desires and needs.
- *a fundamental educational program that can serve educational priorities, whether they are academic education, general education, vocational education, career education, ad. inf.
- *an activity based curriculum enabling students to learn through doing.
- *logically a discipline with a curriculum continuum from grade K through 12.

INDUSTRIAL ARTS IS JUSTIFIED BECAUSE

- *all persons need to know about the technological environment, the material culture, and industry because they are economically, socially and emotionally affected by them.
- *all persons must make a career choice from an extremely large and increasing number of occupations that are affected by technology; therefore, they should have opportunities to develop interests, uncover talents, explore technical and applied science fields and study occupations.
- *all persons must select, buy, use, and maintain the products of industry -- houses, automobiles, appliances, clothes, furniture and items of a never ending list. A knowledge of products, their manufacture, characteristics, advantages and disadvantages makes for intelligent consumption.
- *all persons need recreational, leisure time and avocational outlets.
- *all persons need to have opportunities to develop planning, creative, problem solving and technical skills in harmony with their inherent desire to seek the better way.

INDUSTRIAL ARTS CAN HELP THE STUDENT TO

- *gain an understanding of industry and technology.
- *discover interests and talents.
- *develop techniques in problem solving.
- *develop basic skills in the safe use of tools and machines.
- *make informed and meaningful occupational choices.
- *acquire interests in avocational pursuits and hobbies.
- *develop safe working habits.
- *apply other school subjects.
- *become a wiser consumer.
- *develop creativity.
- *develop pride in work well done.
- *work cooperatively with others.

THE INDUSTRIAL ARTS MISSION

The mission of Industrial Arts Education is to assist the student in developing an understanding about industry and technology and in the discovery and development of individual potential.

GOALS

Consistent with their abilities, interests and educational needs:

1. Industrial Arts students at the middle or junior high school level will be aware of employment and/or self-employment opportunities and requirements for use in making career choices and in determining their educational programs.
2. Industrial Arts students at the senior high school level will acquire technical competencies in preparation for advanced vocational or technical education programs.
3. Industrial Arts students at the senior high school level will acquire competencies that lead to responsible citizenship through technological understanding, consumer knowledge and the productive use of leisure time.

INDUSTRIAL ARTS: AN OFFICIAL DEFINITION

Industrial Arts education programs means those education programs which pertain to the body of related subject matter, or related courses, organized for the development of understanding about the technical, consumer, occupational, recreational, organizational, managerial, social, historical, and cultural aspects of industry and technology including learning experiences involving activities such as experimenting, designing, constructing, evaluating, and using tools, machines, materials, and processes which provide opportunities for creativity and problem solving or assist individuals in the making of informed and meaningful occupational choices or which prepare students for entry into advanced trade and industrial or technical education programs.

INDUSTRIAL ARTS INSTRUCTIONAL OBJECTIVES

Industrial Arts students at the Senior High School Level will acquire competencies that lead to responsible citizenship through technological understanding, consumer knowledge and the productive use of leisure time. The program stresses the following instructional objectives:

1. Develop an insight and understanding of industry and technology, its place in our society and the free enterprise system.
2. Discover and develop individual talents, aptitudes, interests, and potentials as related to industry and technology.
3. Develop an understanding of industrial processes and the practical application of scientific principles.
4. Develop technical problem-solving and creative abilities involving the use of materials, processes, and products of industry and technology.
5. Develop an understanding of industrial and technological career opportunities and their requirements and develop those traits which will help students obtain and maintain employment.

As determined by Title II of PL No. 94-482, the Vocational Education Act of 1976 and the State Board for Vocational Education, the purpose of funding industrial arts programs with vocational monies will be to:

1. Assist individuals in the making of informed and meaningful occupational and educational choices.
2. Prepare individuals for enrollment in advanced or highly skilled vocational and technical programs.

NORTH DAKOTA INDUSTRIAL ARTS CURRICULUM

Program Scope and Sequence Model

JUNIOR HIGH LEVEL I

(7-9)

Orientation and Exploration

ELEMENTARY LEVEL

(k-5)

Awareness

SENIOR HIGH LEVEL II

(10-12)

Personal Enrichment

Pre-Technical

At the elementary level, learning experiences in industrial arts will be directed primarily toward the child's development of an awareness of industry/technology and the world of work. The concepts and activities will be integrated with the elementary curriculum to enrich and reinforce the common learning areas.

INSIGHTS INTO INDUSTRY & TECHNOLOGY

A broad overview of industry and technology. Learning experiences will be directed toward the student's exploration of the historical, present, and future potentials of industry and technology.

GRAPHIC COMMUNICATIONS TECHNOLOGY

MANUFACTURING TECHNOLOGY

CONSTRUCTION TECHNOLOGY

ENERGY/POWER TECHNOLOGY

DESIGN/DRAFTING
PHOTOGRAPHY
GRAPHIC ARTS
CONSTRUCTION
DRAFTING
INDIVIDUAL TECHNICAL
PROBLEMS

PRODUCTION

WOOD TECHNOLOGY
PLASTIC TECHNOLOGY
METAL TECHNOLOGY
INDUSTRIAL CRAFTS
INDIVIDUAL TECHNICAL
PROBLEMS

ENERGY SOURCES
POWER TECHNOLOGY
ELECTRICAL / ELEC-
TRONIC TECHNOLOGY
TRANSPORTATION
TECHNOLOGY
INDIVIDUAL TECHNICAL
PROBLEMS

THE INDUSTRIAL ARTS PROGRAM OF STUDIES

LEVEL	GOAL	PROGRAM
II HIGH SCHOOL (Grades 10, 11, & 12)	1. Personal Enrichment 2. Pre-Technical	GRAPHIC COMMUNICATIONS TECHNOLOGY *Design/Drafting *Photography *Graphic Arts *Construction Drafting *Industrial Technical Problems ENERGY/POWER TECHNOLOGY *Energy Sources *Power Technology *Electrical/Electronic Technology *Transportation Technology *Individual Technical Problems PRODUCTION TECHNOLOGY *Wood Technology *Metal Technology *Plastic Technology *Industrial Crafts *Individual Technical Problems
		INDIVIDUAL TECHNICAL PROBLEMS (Multiple Offerings)
I JUNIOR HIGH SCHOOL (Grades 7, 8, & 9)	1. Orientation 2. Exploration	*Insights into Industry and Technology *Graphic Communications Technology *Manufacturing Technology *Construction Technology *Energy/Power Technology

PROGRAM STANDARDS FOR INDUSTRIAL ARTS

ELEMENTS OF QUALITY INDUSTRIAL ARTS PROGRAMS

The success and quality of programs in industrial arts education depends upon elements that influence the quality of programs. Industrial arts must be responsive to the following elements:

- A. **GOALS AND OBJECTIVES:** Program goals and objectives are established that provide the inspiration and guidance in program development, operation and evaluation.
- B. **INSTRUCTIONAL STAFF:** The instructional staff is competent and meet necessary qualifications.
- C. **INSTRUCTIONAL PLAN:** Selected subject matter is appropriate to learner's level and consistent with curriculum and course goals and objectives.
- D. **STUDENT ORGANIZATIONS:** The establishment and operation of effective student organizations.
- E. **FACILITIES AND EQUIPMENT:** Instructional facilities are well-designed, located and supportive of accomplishing curricular goals. (Refer to Educational Specifications for Industrial Arts Instructional Facilities Handbook, 1978.)
- F. **SPECIAL NEEDS:** The program must provide for disadvantaged and handicapped students.
- G. **ADVISORY COMMITTEES:** The establishment and effective use of industrial arts advisory committees.
- H. **GUIDANCE:** The teacher's role in guidance.
- I. **ADMINISTRATION:** Administration of the industrial arts program.
- J. **EVALUATION:** Evaluation procedures are planned and implemented to assure continual program improvement.

NOTE: For further information on program standards, refer to the NORTH DAKOTA VOCATIONAL/TECHNICAL EDUCATION PROGRAM STANDARDS, Section 11.1 to 11.7.

INDUSTRIAL ARTS COURSE CODE NUMBERS (Vocationally Funded)

Insights Into Industry and Technology	10001
Construction Technology	10011
Manufacturing Technology	10021
Wood Technology	10023
Metal Technology	10026
Plastic Technology	10029
Energy and Power Technology	10031
Electrical/Electronic Technology	10033
Energy Sources	10038
Power Technology	10039
Graphic Communications Technology	10051
Graphic Arts	10052
Design/Drafting	10053
Photography	10054
Construction Drafting	10056
Transportation	10061
Industrial Crafts	10080
Individual Technical Problems	10091
Individual Technical Problems	10092

PART II:
PLASTIC TECHNOLOGY
COURSE GUIDE
(# 10029)

PLASTIC TECHNOLOGY

Rationale:

Because of the importance of industrial arts as a subject at the senior high school level with certain basic assumptions, be it resolved that it is worthwhile for all students to understand and manage their industrial technology environment. The study of production technology, in its broadest sense, is a study of the technology as it relates to other technologies and education in the overall school curriculum. The production technology is a body of knowledge organized in such a way that it aids students in the making of informed and meaningful future choices. Moreover, the production technology consists of instruction in wood, plastics, metal, and industrial crafts industries. These instruction areas are considered as courses with numerous major units of study to permit the students to see the importance of industrial arts in relationship to their place and goals in our industrialized society.

The course in plastic technology includes units of instruction that will acquaint students with the many plastic materials, the forms in which they exist, and the basic industrial processes used in production. It will also provide the student with an awareness of the historical and present role plastics play in our society.

Course Objectives:

Industrial arts students, at the senior high level, will acquire competencies in Plastic Technology that lead to responsible citizenship through technological understanding, consumer knowledge and the productive use of leisure time. This course stresses the following instructional objectives:

- (1) Develop an insight and understanding of plastic technology, its place in our society and the free enterprise system.
- (2) Discover and develop individual talents, aptitudes, inerests and potentials as related to plastic technology.
- (3) Develop technical problem solving and creative abilities involving the use of tools, materials, products and processes of plastic technology.
- (4) Develop an understanding of plastic technology career opportunities.

Guidelines For Implementation

Success in the classroom or laboratory depends on many factors. Foremost among these is the planning effort on the part of the teacher. Educational programs must be flexible and adaptable. They must be flexible enough to remain adaptable to all locales, in numerous types of facilities, and with students possessing differing values and interest. Therefore, a successful program must be capable of application in both small and large schools.

The industrial arts program recommended by these course guides are designed to meet individual student needs. They provide teachers with guidelines for a well balanced program with suggested teacher options in each of the three major technical study areas: (1) Graphic Communications; (2) Energy/Power; and (3) Production. The North Dakota secondary school industrial arts program suggests three levels of learning with an alternative curriculum approach at the Level II for those schools that cannot offer specific courses identified for each of the three technical study areas due to the size of enrollments or other limiting factors.

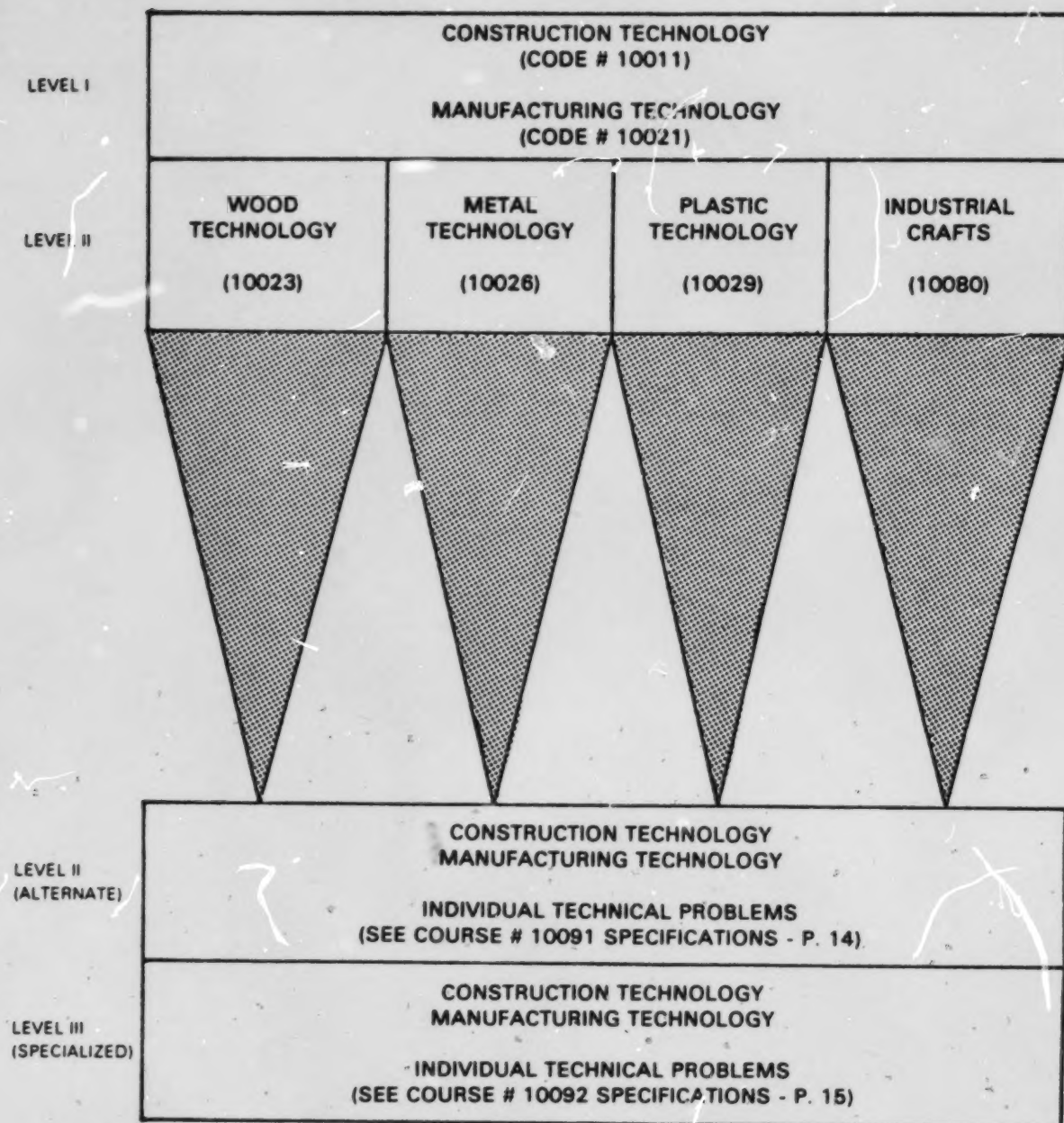
Production Technical Area Guidelines

The recommended scope and sequence of course offerings for the production technical study area is illustrated on the sample program model on page 13. The Level I courses (Manufacturing Technology and Construction Technology) are recommended as prerequisites for the production courses listed at Level II. The senior high Level II courses provide concentrated and indepth exploratory experiences in four production courses: (1) Wood Technology; (2) Metal Technology; (3) Plastic Technology; and (4) Industrial Crafts. Since students at the high school level display a wide range of interests, abilities, and life goals, the industrial arts program must provide a variety of learning experiences and options to meet individual needs. To meet the varied student needs, it is recommended that the specific courses be made available to students when possible. For the smaller and mid-sized schools, it may not be feasible to offer all four of the specific production courses identified for Level II. If that should be the case, it is recommended that one or two of the courses be offered and an ITP (Individual Technical Problems) course be offered as a Level II alternative. (See ITP Course specifications on page 14). This course is designed to provide multiple experiences in production to meet individual needs.

The Level III ITP course (Code #10093) is suggested for students in larger programs who have had the Level II indepth exploratory courses in the production area and desire to study a specialized aspect related to industrial materials, production processes, and/or production organization. (See pages 15 and 16 for specific Level III ITP Course specifications and study options).

Guidelines For Implementing the Plastic Technology Course

1. Identify personnel who aid in curriculum change, development and implementation.
2. Identify and gain support of administration, civic & parent orgs.
3. Arrange for a detailed presentation of the program to key personnel.
4. School system should make the program universal throughout all schools, if two or more.
5. Arrangements should be made for the purchase of software and hardware.
6. Arrangements should be made for inservice preparation of all teachers of the production technology program.
7. Scheduling of instructional units may be adjusted to accomodate students and the instructional year.



Sample Program Model

INDIVIDUAL TECHNICAL PROBLEMS

COURSE CODE: 10091

This individual technical problem course is designed for students who have not had the opportunity to enroll in specific Level II subject matter courses in the Production Technology cluster area. The course is designed to provide a means for meeting individual student needs through the offering of multiple activities in a number of technical areas in schools where separate courses are not available.

INDUSTRIAL ARTS PURPOSE	SELECTED STUDENT COMPETENCIES
Personal Enrichment Pre-Technical	NOTE: Individual student competencies and learning experiences are to be identified and developed on a contractual basis by the student and approved by the instructor for each problem.
GRADE LEVEL	SAMPLE LEARNING TOPICS
11 - 12	NOTE: Learning topics for the ITP are to be selected from the instructional units identified for each specific subject matter course. These courses include: PRODUCTION TECHNOLOGY: -- Wood Technology, 10023 -- Metal Technology, 10026 -- Plastic Technology, 10029 -- Industrial Crafts, 10080
COURSE LENGTH	
One period per day 18 or 36 weeks	
UNIT OF CREDIT	
½ or 1 unit	
RECOMMENDED PREREQUISITES	
Level I Curriculum Courses	

INDIVIDUAL TECHNICAL PROBLEMS: PRODUCTION

COURSE CODE: 10092

This individual technical problem course is designed for students who have had the Level II preliminary course of this cluster in the chosen area of study and intend to study specific information and techniques in wood, plastic, metal technology courses and/or industrial crafts.

INDUSTRIAL ARTS PURPOSE Personal Enrichment Pre-Technical	Instruction in this industrial arts course is open to meet student needs. The following suggested objectives are meant to provide ideas for developing students programs. 1. To prepare students for seeking advanced education in the area of production. 2. To provide students the experiences in problem-solving, research and development with regard to any specific topic in production courses. 3. To provide students with information regarding industrial materials, processes and the practical applications of scientific principles. 4. To provide students with an understanding of industry, it's place in society, and the free enterprise system. 5. To provide students with an understanding in related career opportunities in production.
GRADE LEVEL 11 - 12	
COURSE LENGTH One period per day 18 or 36 weeks	
UNIT OF CREDIT $\frac{1}{2}$ or 1 unit	
RECOMMENDED PREREQUISITES Level I Curriculum Courses and Level II	

INDIVIDUAL TECHNICAL PROBLEMS:

PRODUCTION

SAMPLE LEARNING UNITS

WOOD TECHNOLOGY:

- I. Anatomical Structure of Wood
- II. Forest Ecology
- III. Physical Nature of Wood
- IV. Wood Defects
- V. Lamination Processes
- VI. Peg Diffusion
- VII. Wood Plastic Composition
- VIII. Residential Construction
 - A. Sub-structure
 - B. Super-structure
- IX. Commercial Construction
- X. Wood By-Products
- XI. Product Design
- XII. Product Finishing
- XIII. Preservation Materials
- XIV. Occupations - Present and Future
- XV. Safety Development
- XVI. Prototype Construction
- XVII. Bending Fixtures

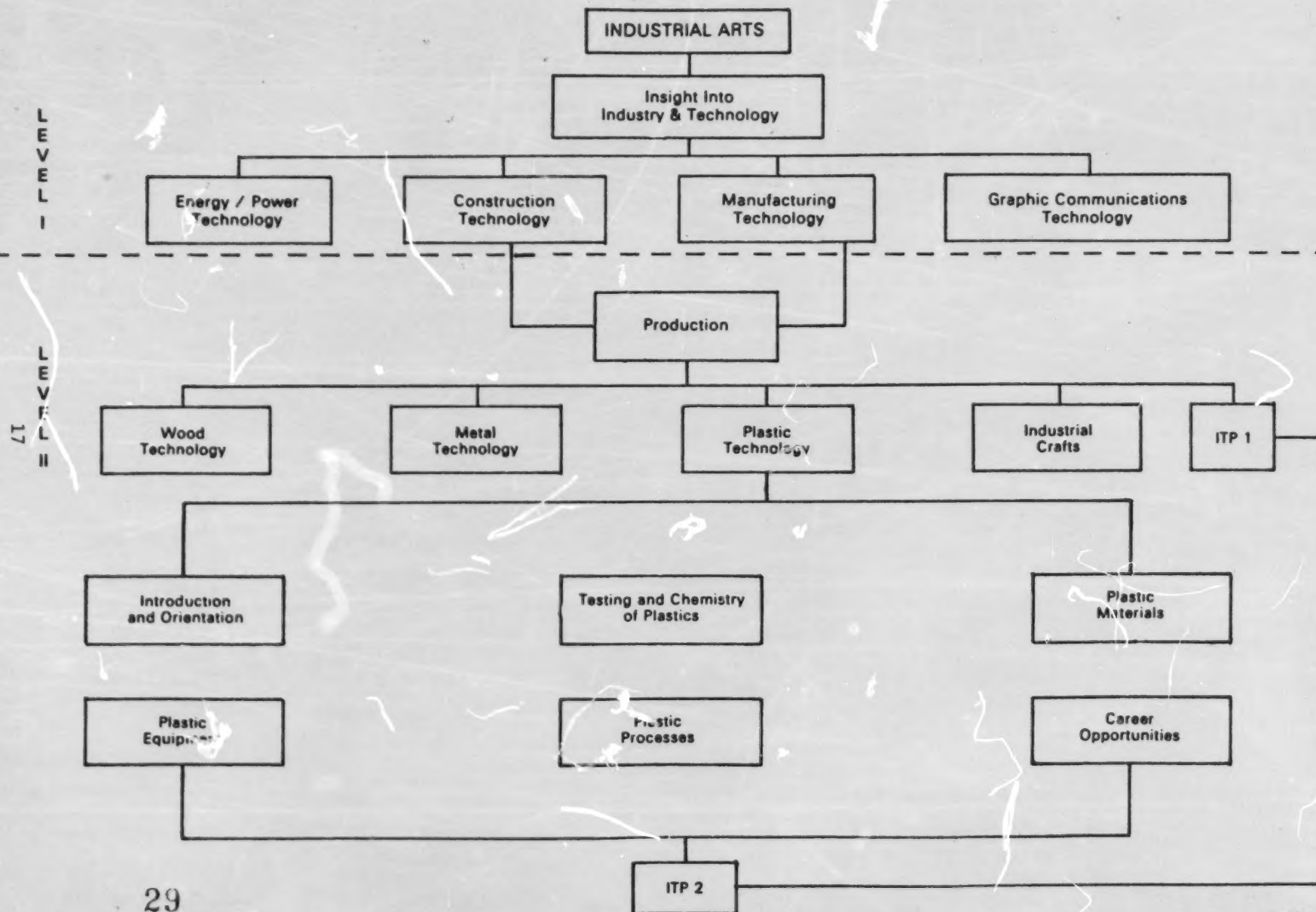
METAL TECHNOLOGY:

- I. EDM
- II. Chemical Milling
- III. Explosive Forming
- IV. Adhesives
- V. Investment Casting
- VI. Forging
- VII. Heat Treatment of Metals
- VIII. Metal Turning
- IX. Extrusion Processes
- X. Powder Metallurgy
- XI. Multi-Related Problems
- XII. Automation
- XIII. Accident Prevention Study

PLASTIC TECHNOLOGY:

- I. Mold Construction
 - A. Expandable Bead Molds
 - B. Liquid Plastic Molding
 - C. Vacuum Forming Molds and Rotational
- II. Decorating and Finishing Applications of Plastic
 - A. Advertising
 - B. Natural Finishes

- III. Study Developments of Future Applications of Plastic
- IV. Uses of and Choices of Bonding Agents
- V. Plastic Products
 - A. Production of Plastic Products
 - B. Study of Industrial Processes
- VI. Study of Optical Properties
- VII. Plastic Products
- VIII. Safety and Health Hazards of Toxic Fumes From Plastic Materials



PLASTIC TECHNOLOGY

COURSE CODE: 10029

This course is designed for students who want to know the nature, processes and career opportunities in Plastic Technology.

INDUSTRIAL ARTS PURPOSE Personal Enrichment Pre-Technical	SELECTED STUDENT COMPETENCIES Experiences and activities of this industrial arts course will enable the student to: 1. Identify the historical aspects of the industry. 2. Demonstrate the skills in application, classification and standard forms of plastic materials. 3. Perform destructive and non-destructive identification, properties and chemicals analysis tests. 4. Demonstrate molding and forming processes. 5. Demonstrate moldmaking principles and design of various materials. 6. Identify and demonstrate bonding processes. 7. Perform low and high pressure laminating processes. 8. Demonstrate encapsulation processes. 9. Identify and perform processes of foaming systems. 10. Identify and demonstrate coating process. 11. Identify and perform dispersion systems. 12. Identify and perform decorating and finishing processes. 13. Discuss, identify, and relate to career opportunities in the plastic technology industry.
GRADE LEVEL 10 - 12	
COURSE LENGTH One period per day 18 weeks	
UNIT OF CREDIT ½ unit	
RECOMMENDED PREREQUISITES Level I Manufacturing Technology, 10021, and Wood Technology, 10023	

PLASTIC TECHNOLOGY

Suggested Instructional Units

	Class Periods	
	(18 wks)	(36 wks)
I. Introduction & Orientation	5	
II. Testing & Chemistry of Plastics	5	
III. Molding & Forming	20	
IV. Molding	10	
V. Fabrication and Bonding	2	
VI. Laminates	30	
VII. Casting Plastics	1	
VIII. Foaming Systems	10	
IX. Coating	3	
X. Dispersion Systems	1	
XI. Decorating	1	
XII. Career Opportunities in Plastic Technology	2	
TOTAL	90	

UNIT I

Introduction and Orientation

OBJECTIVES:

This unit introduces students to the area of plastic technology with:

- (1) An overview of the history and growth of plastics.
- (2) The classification and identification of plastic resins and their standard forms are included.

1.0.0 History and Growth of the Plastic Technology

1.1.0 Scientific development of plastic resins

1.2.0 Early resins: Phenolics, Cellulosics

1.3.0 Design and development of plastic processes

1.3.1 Early machines

1.3.2 Automation and cybernation

1.4.0 Historical development of plastic components and products

2.0.0 Application of Plastic Products

2.1.0 Substitution of plastic materials for existing products

2.1.1 Identification of plastic products by major industries: transportation, manufacturing, construction, electronics

2.2.0 Design for plastic products

3.0.0 Classification and Identification of Plastic Materials

3.1.0 Thermoplastic resins: Polyethylene, polypropylene, vinyls, styrenes, polycarbonate, cellulosics, acrylic, nylon, polyurethane, etc.

3.2.0 Thermoset resins: Phenolics, polyester, amines, silicone, etc.

4.0.0 Standardized Plastic Materials

4.1.0 Plastic material forms: Granules, powders, liquids, paste, sheet, rod and tubing

4.2.0 Resin manufacturing industries

4.3.0 Molding companies

4.4.0 Fabricating companies

SELECTED STUDENT COMPETENCIES AND SAMPLE LEARNING ACTIVITIES FOR

Plastic Technology

UNIT I: Introduction and Orientation

SELECTED STUDENT COMPETENCIES

THE LEARNING ACTIVITIES SHOULD
ENABLE THE STUDENT TO:

- A. Identify basic aspects of the history and growth of plastic technology.
- B. Identify the development of plastic materials as substitutes for existing products.
- C. List plastic components within common production products.
- D. Explain design principles for plastics.
- E. Define thermoplastic and thermoset resin.

SAMPLE LEARNING ACTIVITIES

- A.1 The student will be able to name Phenolics and Cellulosics as early plastics. The student will understand the development of hand processes to automation and then cybernation.
- B.1 The student will discuss early products and the materials they were made of and the use of plastics as substitutes; for e.g., the progression of house wiring from knob and tube to romex and cane fishing poles to fiberglass.
- C.1 The student will discuss the importance of plastics within major industries, for e.g., the automobile as part of the transportation industry uses plastics extensively.
- D.1 Discuss characteristics of plastic products and their suitability, for e.g., the automobile as part of the transportation industry uses plastics extensively.
- E.1 Student will be able to write common thermoplastic names, such as, polyethylene, polypropylene, vinyls, acrylic and nylon.

SELECTED STUDENT COMPETENCIES AND SAMPLE LEARNING ACTIVITIES FOR

Plastic Technology

UNIT I: Introduction and Orientation

SELECTED STUDENT COMPETENCIES

THE LEARNING ACTIVITIES SHOULD
ENABLE THE STUDENT TO:

- F. List the standardized plastic material forms as: Granules, powders, liquids, paste, sheet, rod and tubing.
- G. Understand that resin manufacturing companies produce the standardized plastic materials; molding companies use the standard plastic materials to produce products by such processes as injection and blow molding; and fabricating companies begin with standard sheet and stock plastic materials rather than powders or granules.

SAMPLE LEARNING ACTIVITIES

- E.2 Student will be able to write common thermoset names, such as, phenolics, polyester, silicone and epoxy.
- F.1 Student will experience different forms of standardized plastic materials as available in the lab.
- G.1 Read literature or view a film from major manufacturer of plastics.
- G.2 Take a field trip to a plastics industry to observe molding and production methods.

UNIT II

Testing and Chemistry of Plastics

OBJECTIVES:

This unit introduces students to the area of plastic technology with:

- (1) Basic chemistry of polymers, identification, testing and plastic properties.
- (2) Gaining an understanding of the relationship between material properties and chemistry.

1.0.0 Non-Destructive Tests

1.1.0 Specific gravity test

1.2.0 Classify by sight, touch and smell

2.0.0 Destructive Identification Tests

2.1.0 Heat test

2.2.0 Flam test

3.0.0 Chemical Bonding

3.1.0 Basic chemistry

3.1.1 Atoms, elements, compounds, molecules

3.1.2 Monomers, polymers, polymerization

3.1.3 Molecular shape, relationship of structure to properties

4.0.0 Differential Properties

4.1.0 Chemical, physical and mechanical properties

4.2.0 Thermal and electrical properties

**SELECTED STUDENT COMPETENCIES
AND SAMPLE LEARNING ACTIVITIES
FOR**

Plastic Technology

UNIT II: Testing and Chemistry of Plastics

SELECTED STUDENT COMPETENCIES	SAMPLE LEARNING ACTIVITIES
THE LEARNING ACTIVITIES SHOULD ENABLE THE STUDENT TO: A. Perform specific gravity tests and classify plastics by sight, touch and smell. B. Classify plastics as thermosets or thermoplastics by the heat test. C. Determine the probable resin from a set of unknown samples. D. Discuss the basic chemistry of materials, including atoms, elements, compounds and molecules. E. Discuss the basic chemistry of plastics, including monomers, polymers and polymerization. F. Reconize relationship of structure to properties.	- A.1 Examine commercial products and standardized plastic materials learning to reconize unique characteristics of different resins. - B.1 Given a set of plastic samples and using the heat test, determine which are thermoplastics and which are thermosets. - C.1 Using a reference chart and observing flame color, burning characteristics, and odor, identify the type of resin from unknown samples. - D.1 Develop visuals such as charts or models. - E.1 Develop visuals such as models of monomers and polymers. - F.1 Build a model showing the cross-linked molecular structure of the thermosets and the long-chain molecules of thermoplastics.

**SELECTED STUDENT COMPETENCIES
AND SAMPLE LEARNING ACTIVITIES
FOR**

Plastic Technology

UNIT II: Testing and Chemistry of Plastics

SELECTED STUDENT COMPETENCIES	SAMPLE LEARNING ACTIVITIES
THE LEARNING ACTIVITIES SHOULD ENABLE THE STUDENT TO: G. Compare and contrast the kinds, composition and characteristics of plastics. H. Compare thermal properties of foamed plastics with other insulative materials.	G.1 Perform tests, such as, bending strength, hardness, brittleness, tensile strength, etc. H.1 Construct a display board exhibiting different types of insulative materials and compare R values.

UNIT III

Molding and Forming

OBJECTIVES:

This unit introduces students to the area of plastic technology with:

- (1) Common molding and forming processes.
- (2) Operating characteristics of the machines, resins used and products made by these processes.

1.0.0 Injection Molding

- 1.1.0 Injection molding machines
- 1.2.0 Molding process and molds
- 1.3.0 Resins and products

2.0.0 Blow Molding

- 2.1.0 Blow molding machines
- 2.2.0 Molding process and molds
- 2.3.0 Resins and products

3.0.0 Compression Molding

- 3.1.0 Compression molding machines
- 3.2.0 Molding process and molds
- 3.3.0 Resins and products

4.0.0 Thermoforming: Matched Mold, Vacuum and Pressure

- 4.1.0 Thermoforming machines
- 4.2.0 Molding process
- 4.3.0 Resins and products

5.0.0 Extrusion

- 5.1.0 Extrusion machines
- 5.2.0 Extrusion process and dies
- 5.3.0 Resins and products

UNIT III

6.0.0 Rotational Molding

6.1.0 Rotational molding machines

6.2.0 Processes and molds

6.3.0 Resins and products

**SELECTED STUDENT COMPETENCIES
AND SAMPLE LEARNING ACTIVITIES
FOR**

Plastic Technology

UNIT III: Molding and Forming

SELECTED STUDENT COMPETENCIES

SAMPLE LEARNING ACTIVITIES

**THE LEARNING ACTIVITIES SHOULD
ENABLE THE STUDENT TO:**

- A. Discuss features of injection molding machines and molds.**

Identify appropriate resins and common products of injection molding.

Operate equipment and handle plastic materials in a safe and orderly manner to produce products.

Demonstrate the ability to plan and construct workable dies and molds.

- B. Explain the industrial process of blow molding.**

Identify features of blow molding machines.

Operate a blow molding machine to produce product.

Identify appropriate resin and common products of injection molding.

- C. List features of compression molding machines and molds.**

Operate equipment and handle materials in a safe and orderly manner to produce and

- A.1 Examine operating parts of an injection machine.**

- A.2 Given injection molded products, locate the part-line and sprue point.**

- A.3 Work individually to injection mold a product safely.**

- A.4 Advanced students may plan and construct injection molds using epoxy or steel.**

- B.1 View an industrial film on blow molding.**

- B.2 Name the parts and operating cycles of blow molding machines.**

- B.3 Work individually to blow mold a product.**

- B.4 Collect samples of household products made by blow molding.**

- C.1 Name the parts and operating procedures for compression molding machines.**

- C.2 Compression mold a product in the laboratory.**

**SELECTED STUDENT COMPETENCIES
AND SAMPLE LEARNING ACTIVITIES
FOR**

Plastic Technology

UNIT III: Molding and Forming

SELECTED STUDENT COMPETENCIES	SAMPLE LEARNING ACTIVITIES
THE LEARNING ACTIVITIES SHOULD ENABLE THE STUDENT TO: identify resins and products of compression molding. D. List characteristics of thermoforming machines and molds. Identify resins and products made by thermoforming. Operate equipment and handle materials in a safe and orderly manner to produce thermoformed products. E. Explain the industrial process of extrusion. List resins and products made by extrusion. F. Explain the industrial process of rotational molding. Identify features of rotational molding machines and their operating cycles.	C.3 Collect samples of products made by compression molding. D.1 Name the parts and operating procedures for thermoforming. D.2 Collect samples of thermoformed products. D.3 Thermoform products in the laboratory. E.1 Label the parts of a schematic drawing of an extrusion machine. E.2 Collect samples of extruded products. E.3 Write to extrusion manufacturers asking for samples of their products. E.4 Simulate extrusion by making a suitable die for an injection molder. F.1 Identify industrial products. F.2 List the operating cycles with important data on a lab sheet.

**SELECTED STUDENT COMPETENCIES
AND SAMPLE LEARNING ACTIVITIES
FOR**

Plastic Technology

UNIT III: Molding and Forming

SELECTED STUDENT COMPETENCIES

SAMPLE LEARNING ACTIVITIES

**THE LEARNING ACTIVITIES SHOULD
ENABLE THE STUDENT TO:**

Identify appropriate resins
and common products of
rotational molding.

Safely operate a rotational
molding machine to produce a
product.

F.3 Locate resins and molds in
the laboratory used in
rotational molding.

F.4 Rotational mold a product
in the laboratory.

UNIT IV

Moldmaking

OBJECTIVES:

This unit introduces students to the area of plastic technology with:

- (1) Design and principles which are studied for a variety of plastic shaping processes.

1.0.0 Principles of Moldmaking Design

1.1.0 Moldmaking materials and practices

1.2.0 Elastomers

1.3.0 Casting with silicon rubber

**SELECTED STUDENT COMPETENCIES
AND SAMPLE LEARNING ACTIVITIES
FOR**

Plastic Technology

UNIT IV: Moldmaking

SELECTED STUDENT COMPETENCIES

SAMPLE LEARNING ACTIVITIES

**THE LEARNING ACTIVITIES SHOULD
ENABLE THE STUDENT TO:**

- A. Define moldmaking in terms such as, draft, relief, shrinkage, pattern, sprue, flash and fillets.

Identify examples of good mold design for a product to have desirable properties, such as, strength and stiffness.

List different types of molds used to shape plastics.

List materials suitable for making molds.

- A.1 Select a particular process such as, vacuum forming and design and build a mold or pattern.

UNIT V

Fabrication and Bonding

OBJECTIVES:

This unit introduces students to the area of plastic technology with:

- (1) Fabrication involving cutting, shaping and fastening of plastic parts made from stock material.
- (2) The assembly of molded plastic products with various types of fastening devices, also included.

1.0.0 Fabrication and Bonding

1.1.0 Welding and cementing

1.1.1 Cementing: Plastics, solvents, processes

1.1.2 Welding

1.1.2.1 Types: Fusion, friction, hot gas and ultrasonic welding

1.2.0 Machinery plastics

1.2.1 Cutting by sawing and shearing

1.2.2 Drilling, turning, tapping and threading

1.2.3 Finishing and polishing

1.2.4 Hot staking and heat sealing plastics

1.2.5 Mechanical fastening

**SELECTED STUDENT COMPETENCIES
AND SAMPLE LEARNING ACTIVITIES
FOR**

Plastic Technology

UNIT V: Fabrication and Bonding

SELECTED STUDENT COMPETENCIES

SAMPLE LEARNING ACTIVITIES

THE LEARNING ACTIVITIES SHOULD
ENABLE THE STUDENT TO:

- A. Define adhesion, cohesion and fusion.

List adhesives and cohesives.

- B. Describe the tools and processes used in cutting and shaping plastics.

- C. Describe types of finishes for plastics and the processes to achieve them.

- A.1 Join plastics by solvents, cements and welding.

- B.1 Design and fabricate a project, such as, an acrylic laminate.

- C.1 Sand and buff a project.

UNIT VI

Laminates

OBJECTIVES:

This unit introduces students to the area of plastic technology with:

- (1) Laminated material is made by bonding together two or more layers of material to form a single sheet.
- (2) Laminated plastics; the individual layers may be sheet plastic, or layers of other material bonded to the plastic.
- (3) Learning about different types of laminates and laminate characteristics.

1.0.0 Laminates

1.1.0 Reinforced plastics

- 1.1.1 Resins for reinforced molding
- 1.1.2 Reinforcements
- 1.1.3 Processes

1.2.0 High and low pressure laminating

- 1.2.1 Materials for laminating
- 1.2.2 Laminating process and products

**SELECTED STUDENT COMPETENCIES
AND SAMPLE LEARNING ACTIVITIES
FOR**

Plastic Technology

UNIT VI: Laminates

SELECTED STUDENT COMPETENCIES	SAMPLE LEARNING ACTIVITIES
THE LEARNING ACTIVITIES SHOULD ENABLE THE STUDENT TO: A. Identify plastics that are reinforced. B. Recognize materials that are used to reinforce plastic resins. C. Describe the materials used in polyester resin reinforced plastics. D. Reconize the processes used in making reinforced polyester products and the safety and health precautions. E. Compare high pressure and low pressure laminating. F. Identify the materials used in high pressure and low pressure laminating. G. Write the process cycles used in high pressure and low pressure laminating.	- A.1 Collect and display plastics that have been reinforced. - B.1 Make a list and collect samples of materials used to strengthen plastics. - C.1 Given a list containing such names as mat, cloth, acetone, wax, catalyst, polyester resin, styrene, monomer and gelcote, describe their use in fiberglass work. - D.1 Make a fiberglass product in the laboratory observing safety and health precautions. - E.1 Select a desired project and correctly operate the machine to produce a low pressure laminate. - F.1 Select a desired project and correctly operate the machine to produce a high pressure laminate.

UNIT VII
Casting Plastics

OBJECTIVES:

This unit introduces students to the area of plastic technology with:

- (1) Casting referring to a process where a liquid plastic is poured into a mold.
- (2) Encapsulating, similar to casting except the plastic is cast around an item in the mold.
- (3) Learning about casting plastics.

1.0.0 Casting Plastics

1.1.0 Casting processes, molds and resins

1.2.0 Encapsulating

**SELECTED STUDENT COMPETENCIES
AND SAMPLE LEARNING ACTIVITIES
FOR**

Plastic Technology

UNIT VII: Casting Plastics

SELECTED STUDENT COMPETENCIES	SAMPLE LEARNING ACTIVITIES
THE LEARNING ACTIVITIES SHOULD ENABLE THE STUDENT TO: A. Recognize the materials used and products made in casting plastics. B. Identify the differences between casting and encapsulating.	- A.1 Using the materials, correctly make a cast item in the laboratory. - B.1 Following safe and orderly procedures, make an encapsulated product in the laboratory.

UNIT VIII
Foaming Systems

OBJECTIVES:

This unit introduces students to the area of plastic technology with:

- (1) Foamed plastics which are produced by adding a gas or air to a plastic resin.
- (2) Learning about the methods, materials and products of this important industrial process.

1.0.0 Foaming Systems

1.1.0 Methods of foaming

1.2.0 Characteristics and applications of foam

1.2.1 Expandable bead foam

1.2.2 Expandable resin foam

1.3.0 Foam molding processes

**SELECTED STUDENT COMPETENCIES
AND SAMPLE LEARNING ACTIVITIES
FOR**

Plastic Technology

UNIT VIII: Foaming Systems

SELECTED STUDENT COMPETENCIES	SAMPLE LEARNING ACTIVITIES
THE LEARNING ACTIVITIES SHOULD ENABLE THE STUDENT TO: A. Identify foaming systems used industrially. B. Compare methods of foaming in the laboratory to industrial processes. C. Describe uses of foam in construction and transportation.	- A.1 Define expandable resin foam, expandable bead foam, flexible and rigid foam. - B.1 Identify materials, processes and molds used in the laboratory to make products. - C.1 Appreciating correct procedures, select and make a foam product. - C.2 Collect samples of foam plastics used in construction and transportation.

UNIT IX

Coating

OBJECTIVES:

This unit introduces students to the area of plastic technology with:

- (1) In plastic coating; plastic material (usually powder) is fused to a base material such as, metal, glass or ceramic.
- (2) Students learning about some of the coating processes.

1.0.0 Coating

1.1.0 Coating processes, materials and products

1.2.0 Cold drip coating

1.3.0 Fluidized bed coating

1.4.0 Vacuum metalizing

1.5.0 Electroplating

**SELECTED STUDENT COMPETENCIES
AND SAMPLE LEARNING ACTIVITIES
FOR**

Plastic Technology

UNIT IX: Coating

SELECTED STUDENT COMPETENCIES

SAMPLE LEARNING ACTIVITIES

**THE LEARNING ACTIVITIES SHOULD
ENABLE THE STUDENT TO:**

- A. Define different types of plastic coating processes.
- B. Identify industrial products that are plastic coated.
- C. Describe the plastic coating processes available in our laboratory.

- A.1 Collect samples of products with plastic coatings.
- B.1 Plastic coat a product in the laboratory following correct procedures.
- C.1 Students select and describe various coating processes.

UNIT X
Dispersion Systems

OBJECTIVES:

This unit introduces students to the area of plastic technology with:

- (1) Dispersions; small particles of plastic in suspension in another substance.
- (2) Students investigating plastic dispersions.

1.0.0 Dispersion Systems

1.1.0 Dispersion materials

- 1.1.1 Platisols
- 1.1.2 Organisols

1.2.0 Dispersion processes

- 1.2.1 Dip molding
- 1.2.2 Spray coating
- 1.2.3 Slush molding
- 1.2.4 Rotational molding

1.3.0 Dispersion products

**SELECTED STUDENT COMPETENCIES
AND SAMPLE LEARNING ACTIVITIES
FOR**

Plastic Technology

UNIT X: Dispersion Systems

SELECTED STUDENT COMPETENCIES

SAMPLE LEARNING ACTIVITIES

**THE LEARNING ACTIVITIES SHOULD
ENABLE THE STUDENT TO:**

A. Define dispersions and identify
plastisols and organosols.

A.1 Using styrofoam balls and
toothpicks, represent the
chemical composition and
bonds of a plastic resin.

B. List plastic resins used in
dispersions.

B.1 Select a process and make
a product in the laboratory
using a plastic dispersion,
such as, plastisol dip
coating pliers handles.

C. Define the dispersion processes
of dip, spray, slush and rota-
tional molding.

Name industrial dispersion
products.

C.1 Write to manufacturers
requesting products made
from dispersions.

UNIT XI

Decorating

OBJECTIVES:

This unit introduces students to the area of plastic technology with:

- (1) Plastic products which are painted, coated, colored, textured and embellished with messages and designs.
- (2) Students learning about decorating and finishing plastics.

1.0.0 Decorating

1.1.0 Decorating, coloring, finishing and restoration

1.2.0 Hot stamping

1.2.1 Hot stamping die

1.2.2 Hot stamping process

1.3.0 Silk screen printing

1.4.0 Painting

1.5.0 Engraving

SELECTED STUDENT COMPETENCIES
AND SAMPLE LEARNING ACTIVITIES
FOR

Plastic Technology

UNIT XI: Decorating

SELECTED STUDENT COMPETENCIES

SAMPLE LEARNING ACTIVITIES

THE LEARNING ACTIVITIES SHOULD
ENABLE THE STUDENT TO:

- A. State processes by which plastic products are decorated.
- B. Given samples of decorated plastics, identify the process used to achieve the finish.
- C. List the correct materials and steps to decorate a plastic in the laboratory.

- A.1 Collect examples of plastic products that have been decorated by a variety of means.
- B.1 Appreciating correct procedure, decorate a plastic product in the laboratory.

UNIT XII

Career Opportunities in Plastic Technology

OBJECTIVES:

This unit introduces students to the area of plastic technology with:

- (1) Acquainting the student with levels of employment and types of occupations in the plastic industry.

1.0.0 Career Opportunities in Plastic Technology

1.1.0 Levels of employment

- 1.1.1 Professional
- 1.1.2 Skilled
- 1.1.3 Semi-skilled
- 1.1.4 Unskilled

1.2.0 Survey of occupations

1.3.0 Outlook for the future

**SELECTED STUDENT COMPETENCIES
AND SAMPLE LEARNING ACTIVITIES
FOR**

Plastic Technology

UNIT XII: Career Opportunities in Plastic Technology

SELECTED STUDENT COMPETENCIES	SAMPLE LEARNING ACTIVITIES
THE LEARNING ACTIVITIES SHOULD ENABLE THE STUDENT TO: A. Detail the growth of plastics in products. B. Detail the growth of the plastics industry. C. Give a specific example of a job title and duties for each level of employment.	- A.1 Construct charts that illustrate the growth in the use of plastics. - B.1 Read and summarize types of jobs in the plastics industry.

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Baird, Ronald J. Industrial Plastics. South Holland, Illinois: The Goodheart-Willcox Company, 1976.

Richardson, Terry A. Modern Industrial Plastics. Indianapolis, Indiana: Bobbs-Merrill Educational Publishing Company, 1979.

Steel Gerald L. Exploring the World of Plastics. Bloomington, Illinois: McKnight Publishing Company, 1977.

Swanson, Robert S. Plastics Technology. Bloomington, Illinois: McKnight & McKnight Publishing Company, 1965.

Periodicals:

1. Canadian Plastics
2. Modern Plastics
3. Modern Plastics Encyclopedia
4. Plastics World

Plastic Industry Organizations: (Publications are available)

1. The Society of the Plastics Industry Inc.
2. The Society of Plastics Engineers Inc.
3. The Plastics Education Foundation